

JC07 Rec'd PCT/PTO 1 0 DEC 2001

FORM PTO-1390) (REV. 9-2001)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER 367.40917X00 filed December 10, 2001	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. 10/009333 (known, see 37 CFR 1.5)	
INTERNATIONAL APPLICATION NO. PCT/GB00/02249		INTERNATIONAL FILING DATE June 9, 2000		PRIORITY DATE CLAIMED June 10, 1999	
TITLE OF INVENTION A DISPLAY MODULE					
APPLICANT(S) FOR DO/EO/US JOHNSON, TERRENCE PHILIP LEWIS, IAN DAVID					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</p> <p>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>a. <input type="checkbox"/> is transmitted hereto (required only if not communicated by the International Bureau).</p> <p>b. <input checked="" type="checkbox"/> has been communicated by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office(RO/US)</p> <p>6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <p>a. <input checked="" type="checkbox"/> is attached hereto.</p> <p>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</p> <p>7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</p> <p>b. <input type="checkbox"/> have been communicated by the International Bureau.</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p>Items 11 to 20 below concern document(s) or information included:</p> <p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input checked="" type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>20. <input checked="" type="checkbox"/> Other items or information: Figs. 1-2,3a-3b,4a-4b,5a-5b,6a-6b,7,8a-8b; Credit Card Payment Form; PCT Request Form; International Publication No. WO 00/77563; International Preliminary Examination Report</p>					

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367.40917X00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: P. JOHNSON, et al
 Serial No.: Not yet assigned
 Filed: December 10, 2001
 For: DISPLAY MODULE
 Group: Not assigned

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
 Washington, D.C. 20231

December 10, 2001

Sir:

Prior to examination, please amend the above-identified application as follows.

IN THE CLAIMS

Please cancel claims 15, 17 and 18 without prejudice or disclaimer of the subject matter thereof.

Please amend the claims as follows:

5. (Amended) A display module as claimed in claim 3, wherein the flexible driver support is a flexible printed circuit (FPC) foil.

6. (Amended) A display module as claimed in claim 1, wherein the intermediate element is flexible.

8. (Amended) A display module as claimed in claim 1, wherein the intermediate

element comprises LCD device power control circuitry.

9. (Amended) A display module as claimed in claim 1, wherein the first and second display drivers are on opposed sides of the LCD.

10. (Amended) A display module as claimed in claim 1, wherein the display drivers are positioned along the first axis.

11. (Amended) A display module as claimed in claim 1, wherein the intermediate element interconnects the first and second display drivers.

12. (Amended) A portable device comprising a display module as claimed in claim 1.

13. (Amended) A radio communications device comprising a display module as claimed in claim 1.

14. (Amended) A radiotelephone comprising a display module as claimed in claim 1.

IN THE ABSTRACT

Please replace the Abstract with the attached Abstract.

REMARKS

Attached hereto is a marked-up version of the changes made to the claims by the current Amendment. The attached page is captioned "**Version with markings to show changes made**".

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED

A display module is disclosed which may be employed in a portable device or the like. The module comprises a liquid crystal display device comprising a liquid crystal display, and a display driver element for driving the LCD. It also comprises a connector for connecting LCD device circuitry to the portable device, and an intermediate element for interfacing the LCD device and the connector.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please cancel claims 15, 17 and 18 without prejudice or disclaimer of the subject matter thereof.

Please amend the claims as follows:

5. (Amended) A display module as claimed in claim 3 ~~or 4~~, wherein the flexible driver support is a flexible printed circuit (FPC) foil.

6. (Amended) A display module as claimed in ~~any preceding~~ claim 1, wherein the intermediate element is flexible.

8. (Amended) A display module as claimed in ~~any preceding~~ claim 1, wherein the intermediate element comprises LCD device power control circuitry.

9. (Amended) A display module as claimed in ~~any previous~~ claim 1, wherein the first and second display drivers are on opposed sides of the LCD.

10. (Amended) A display module as claimed in ~~any previous~~ claim 1, wherein the display drivers are positioned along the first axis.

11. (Amended) A display module as claimed in ~~any previous~~ claim 1, wherein the intermediate element interconnects the first and second display drivers.

12. (Amended) A portable device comprising a display module as claimed in ~~any preceding~~ claim 1.

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A Display Module

The present invention relates to a display module. In particular, the invention relates to the configuration of a display module for a portable device.

Current display devices comprise a liquid crystal display (LCD) and a driver. Typically, the driver is mounted on a printed circuit board (PCB) of the portable device and connections are routed between the LCD and PCB. Figures 8(a) and (b) of the accompanying drawings illustrate display devices having single and x-y driver LCD displays respectively.

According to the present invention, there is provided a display module for a portable device, comprising a liquid crystal display device comprising a liquid crystal display (LCD), and a display driver element for driving the LCD, a connector for connecting LCD device circuitry to the portable device, and an intermediate element for interfacing the LCD device and the connector.

This configuration of display device, with an integrated driver, results in a reduction in the number of connections required for connection to the portable device, thus improving reliability and reducing the display space required. Moreover, it facilitates assembly and serviceability of the portable device as well as module reusability.

The intermediate element is preferably located substantially behind the LCD device, so as to further reduce the area of the display module. The area of the display may be yet further reduced by the provision of a display driver element comprising a flexible driver support. Such a support may be folded back from the LCD to contact an intermediate element positioned behind the LCD, for example.

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Likewise, the intermediate element may be flexible, thereby enabling bending to contact the driver element (or support) and to bring the connector into contact with the portable device.

The flexible driver support and/or flexible intermediate element may be an flexible printed circuit (FPC) foil, thereby being lightweight and durable.

The intermediate element preferably comprises LCD power control circuitry. This leads to a further reduction in the number of connections required to be made to the portable device, and display space required in the portable device.

In an embodiment of the present invention, the LCD device of the display module comprises first and second driver elements comprising respective first and second drivers for driving the LCD. These first and second driver elements may be positioned on opposed sides of the LCD, in which case the intermediate element preferably interconnects the first and second driver elements. Further, the LCD may comprise first and second liquid crystal cells driven by the respective first and second driver elements.

This configuration of display device reduces the routing required between the drivers and cells compared with that shown in Figure 8(a), having a single liquid crystal cell of the same size. Consequently, the resolution is improved for that size of display. Likewise, the size of display is increased for a given resolution. This configuration also has a better contrast ratio over the single driver solution due to the lower multiplexer (MUX) rate. Moreover, the active area to glass ratio is improved since the number of conductive tracks which need to be routed to each driver is substantially reduced, compared to a single driver arrangement. Subsequently, having a reduced number of conductive tracks further reduces the amount space around the edge of the glass plates used for routing the conductive tracks.

According to another aspect, there is provided a portable device comprising a display module of the present invention.

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Figures 6a and 6b respectively illustrate horizontal and vertical configurations of the LCD device of different embodiments of the present invention;

Figure 7 illustrates a portable device comprising a display device of the present invention; and

Figures 8a and 8b illustrate conventional display devices, Figure 8a illustrating a device with a single display driver and Figure 8b illustrating a device with an x-y driver.

Figure 1 is a block diagram of a display device according to an embodiment of the present invention. The display device 10 comprises an LCD panel 11, two display drivers 14, 15 and an FPC unit 16. The LCD panel 11 is a "split" display. That is, it consists of two LCDs 12, 13 made up of individual cells sandwiched between common glass plates. The glass plates have a conductive coating, as is typical in LCD devices. The LCD 12 is driven by one of the display drivers, namely master display driver 14 and the LCD 13 is driven by the other display driver, slave driver 15. The master and slave drivers 14, 15 are synchronised and the two cells are abutted so that the two LCDs 12, 13 look like a single large display. The FPC unit 16 couples the master and slave display drivers and interfaces with external circuitry to obtain the necessary control and data signals and the like. The FPC unit may comprise the power supply control circuitry as will be explained further below with reference to Figures 2, 4a and 4b.

In this embodiment, serial interface signals (such as serial clock period (SCL), serial interface (SI), data/command indicator (AO), master and slave chip select (master XCS, slave XCS) and reset timing signals) are received by the FPC unit 16 as the serial interface for the display device 10. These signals are forwarded to the display drivers 14, 15. The FPC device also receives the

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display device power supply (VDD, VSS). The drivers, in turn, output liquid crystal drive signals to drive the respective LCDs 12, 13.

In this example, the display drivers 14, 15 are Seiko Epson 1565 series dot matrix LCD drivers. These drivers have two main kinds of liquid crystal drive pins, SEG pins which are liquid crystal segment drive outputs and COM pins which are common drive outputs. Synchronisation of these devices when used in a master/slave configuration is handled internally by the driver devices.

As can be seen, in this embodiment the master and slave drivers are positioned on each side of the LCD panel 11. In this horizontal configuration, the routing of common drive outputs in the x-direction is reduced when compared, for example, with a single driver device such as that shown in Figure 8a. Consequently, a high resolution can be attained for large displays. In this case, the LCD panel 11 may have a pixel matrix of 111 x 106, pixel size of 0.19 x 0.22 mm and pixel pitch of 0.22 x 0.24 mm. Also, a reduced display height is also possible when compared, for example, with an x-y driver device of equivalent LCD panel size and resolution, such as that shown in Figure 8b. Furthermore, the device is substantially symmetrical, thus avoiding the need to compensate for any asymmetry when used in a device such as a portable device, as is the case with x-y driver devices. This, in turn, results in weight and volume savings.

As will be appreciated, Figure 1 is merely a block diagram, and the circuitry can be implemented in a number of ways. Two alternative configurations are illustrated in Figure 6.

Figure 2 is an exploded view of a display module 20 according to an embodiment of the present invention. The display module 20 comprises a liquid crystal display screen or panel 21, a lightguide 22, a reflector 23, a plastics support frame 24, two LCD tabs 25 and an FPC foil 26. Optionally,

These components are assembled to form a module as shown in Figure 3a. The tabs 25 are fixedly attached to the display panel 21 to form an LCD tab assembly, as is illustrated in Figure 5a. This attachment may, for instance, be by bonding. The support frame 24 is designed with a recess 241 on its front face for receiving the reflector 23, lightguide 22, diffuser (if desired), and

The next assembly step is to connect the connectors 253 of the tabs 25 to corresponding connectors 263 of the FPC foil 26. The tabs 25 have folds 254

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corresponding to the side edges of the frame, so that they may be wrapped tightly around the support frame 24. They also comprise holes 263 that correspond to the protrusions 245 on the rear of the support frame so as to locate the tab connectors 253 over those 263 of the FPC foil 26. As mentioned above, the connectors are located over the apertures 246 to assist in connection of the connectors. In this embodiment, prior to locating the tabs, a silicon rubber insulator is positioned in the apertures 246 behind the FPC foil connectors 263. The tabs are then located and the FPC foil and tab connectors 253, 263 are heat bonded together (by heating and applying pressure). The insulator is then removed from the module 20. Alternatively, of course, the insulator could be inserted prior to location of the FPC foil or after location of both the FPC foil 26 and the tabs 25.

Figure 3b shows different views of the display module of Figure 2, namely, front, rear, top, bottom and left side views. It also illustrates a pixel array. As mentioned above, in this embodiment, the dimensions shown may have a pixel size (a x d) of 0.19 x 0.22 mm and pixel pitch (b x e) of 0.22 x 0.24 mm. Consequently, in this case there is a horizontal pixel gap c of 0.3 mm and a vertical pixel gap f of 0.2 mm. The LCD cells can be abutted such that only a 0.3mm gap is apparent where they abut which is not noticeable by the human eye.

Figures 4a and 4b illustrate the FPC foil 26 in more detail. The connectors 263, components and tracking 261 may be applied to the foil using any of the known techniques.

Figure 5a shows front, left side and two bottom views of the LCD tab assembly comprising the tabs 25 and the display panel 21. One bottom view shows the assembly flat, and the other with the tabs folded along the folds 254. Figure 5b shows the tabs 25 in more detail. Preferably, the tabs 25 are

made of FPC foil and again the connectors, drivers and tracking are applied to the foil using any of the known techniques.

Figure 6 illustrates two different configurations of a display device with a "split screen", Figure 6a showing a display module 61 with a horizontal configuration, and Figure 6b showing a display module 69 with a vertical configuration. Each display module comprises an LCD panel 62 consisting of two LCDs 65, 66, and two display drivers 67, 68. The LCD 65 is driven by display driver 61, and the LCD 66 is driven by display driver 68. The drivers 67, 68 are synchronised and the cells of LCDs 65, 66 are abutted so that the two LCDs look like a single large display. As in the figure 2 embodiment, the drivers are on tabs 63, 64 and fold under the module to reduce the modules area. The tabs and or a separate element comprise the driver coupling and module interface. Both configurations enable the provision of a small compact module with minimum area and weight to display content. The area of the module is compact and the glass area to active area ratio is excellent. The horizontal configuration provides a minimum product height, whereas the vertical configuration provides a minimum product width.

A radiotelephone 70 comprising a display device 71 of the invention is illustrated in Figure 7. This radiotelephone has all the usual components of a radiotelephone, including an earpiece 74 and microphone 75. In this embodiment, the phone has a slide to extend the gap between the earpiece 74 and microphone 75 to that between a user's ear and mouth when the phone is to be used for conversation. This radiotelephone further comprises function keys 72. These keys are softkeys, that is, their function alters depending upon the item presented on the display 71. Preferably, the display device 71 in this radiotelephone 70 has the horizontal configuration of Figure 6b as its minimum height enables the softkeys (function keys associated with items presented on the display) to be positioned close to the display. Secondly, it facilitates the design of an well proportioned slide phone.

The appended abstract as filed herewith is included in the specification by reference.

1. A display module for a portable device, comprising:
 - a liquid crystal display (LCD) device comprising first and second liquid crystal cells positioned along a first axis of the display;
 - first and second display drivers for respectively driving the first and second liquid crystal cells;
 - a connector for connecting LCD device circuitry to the portable device; and
 - an intermediate element for interfacing the display drivers and the connector.
2. A display module as claimed in claim 1, wherein the intermediate element is positioned substantially behind the LCD device.
3. A display module as claimed in any preceding claim, wherein the display drivers comprise a flexible driver support.
4. A display module as claimed in claim 3, wherein the flexible driver support flexes to contact the LCD and the intermediate element.
5. A display module as claimed in claim 3 or 4, wherein the flexible driver support is a flexible printed circuit (FPC) foil.
6. A display module as claimed in any preceding claim, wherein the intermediate element is flexible.
7. A display module as claimed in claim 6, wherein the intermediate element is an FPC foil.
8. A display module as claimed in any preceding claim, wherein the intermediate element comprises LCD device power control circuitry.

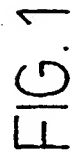


FIG. 1

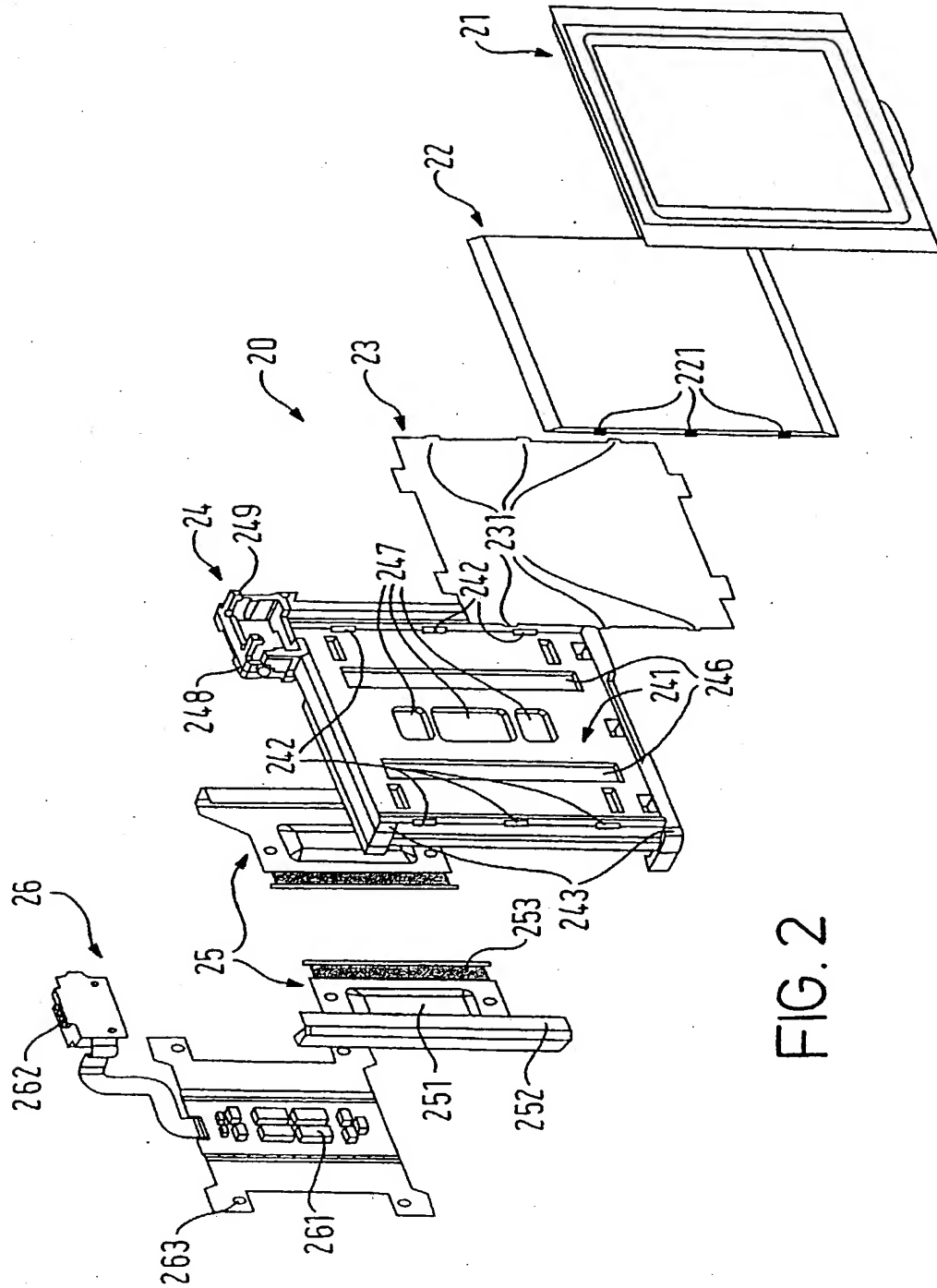
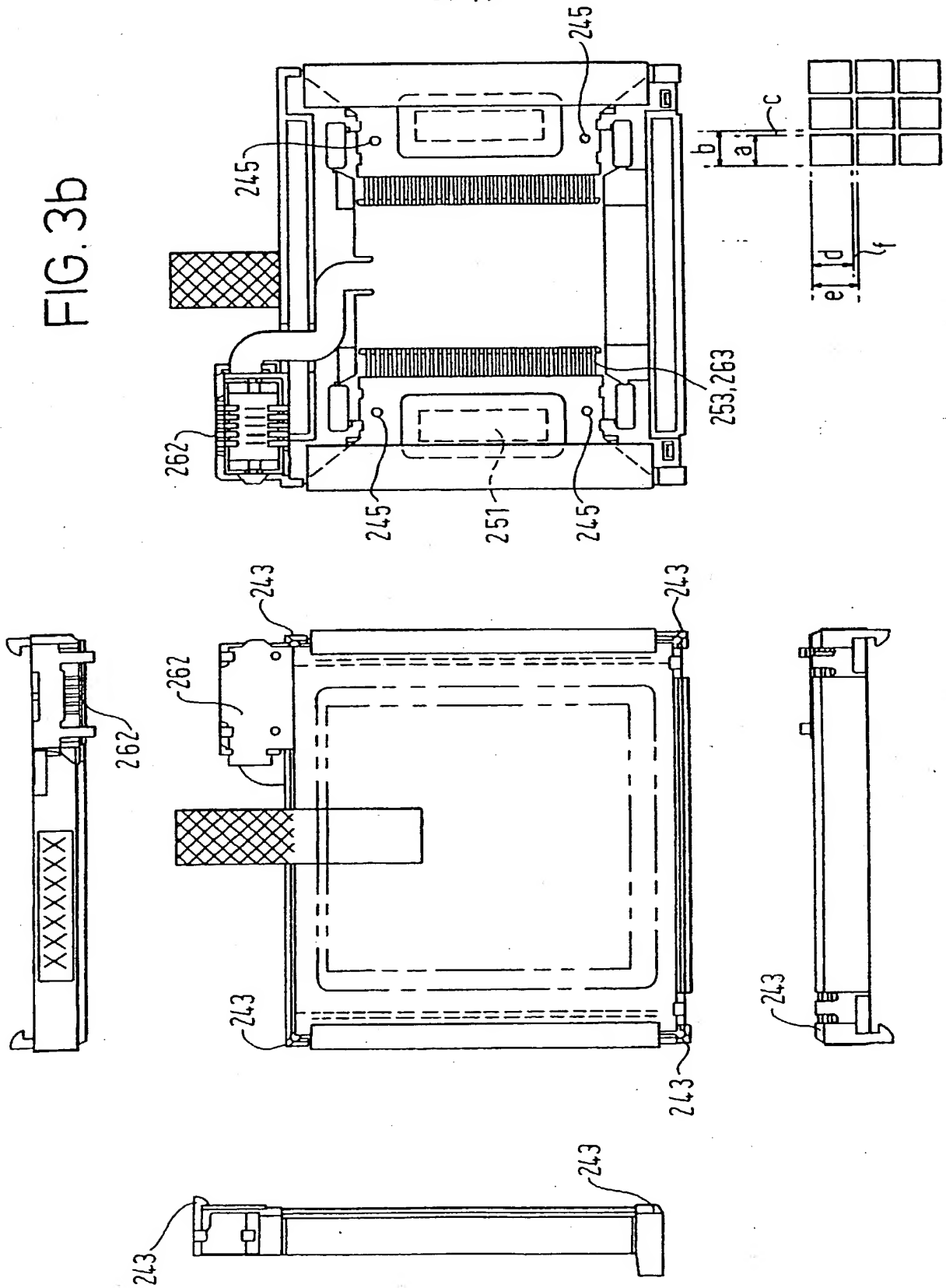


FIG. 2

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FIG. 3b



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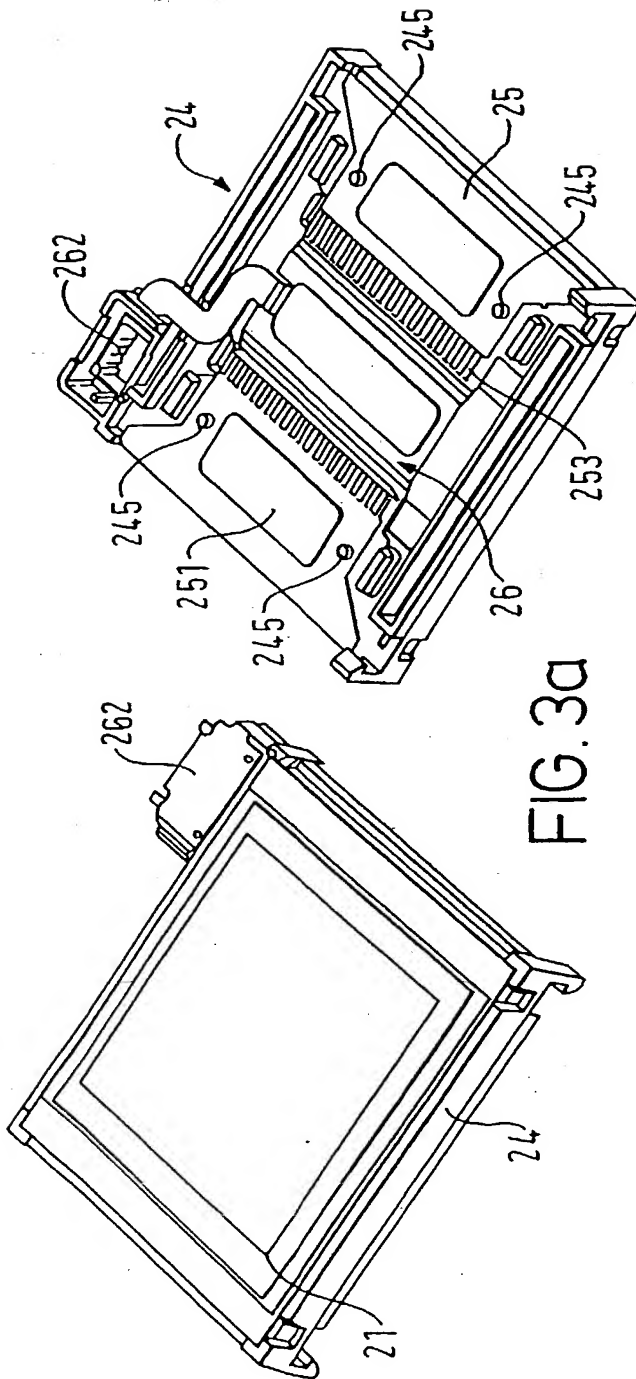


FIG. 3a

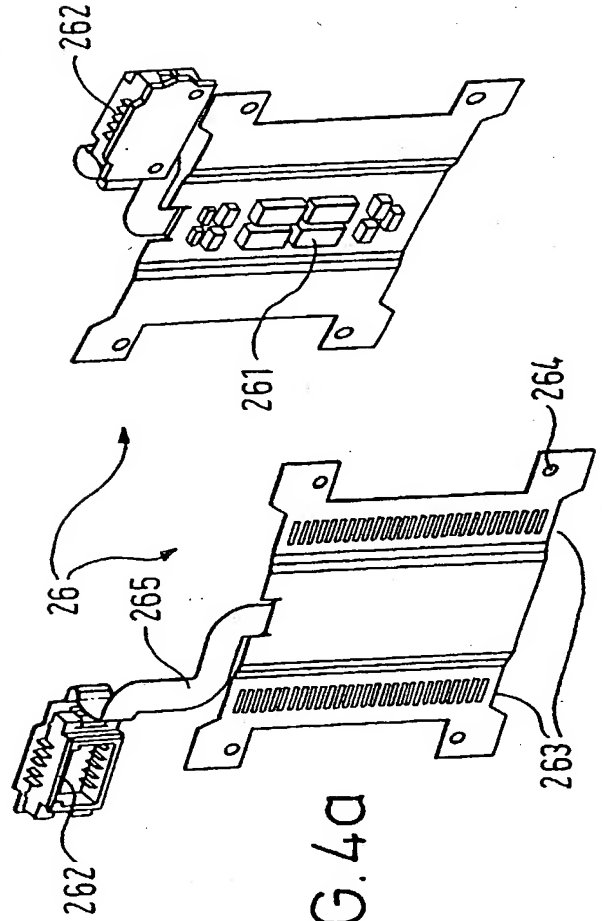


FIG. 4a

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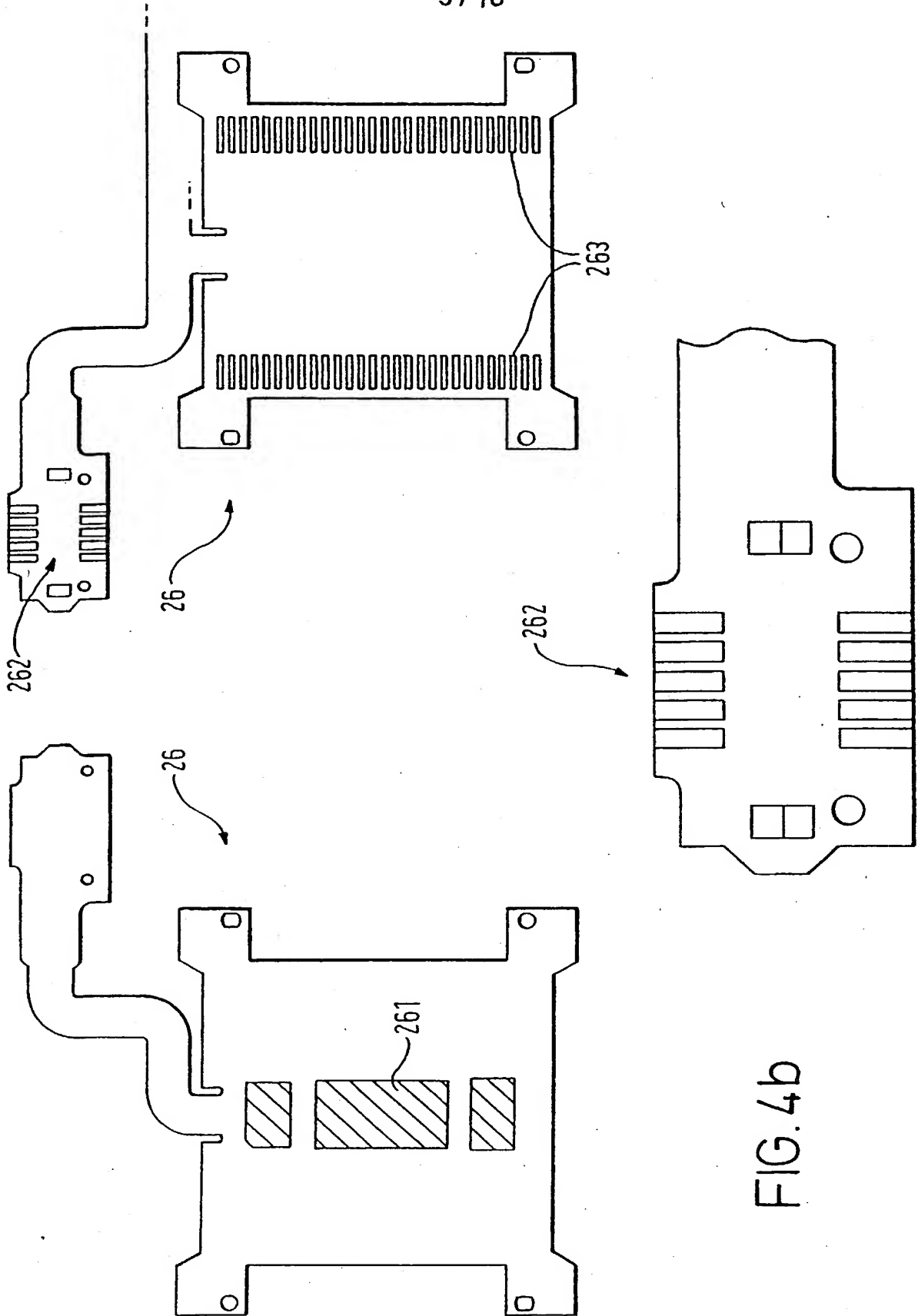


FIG. 4b

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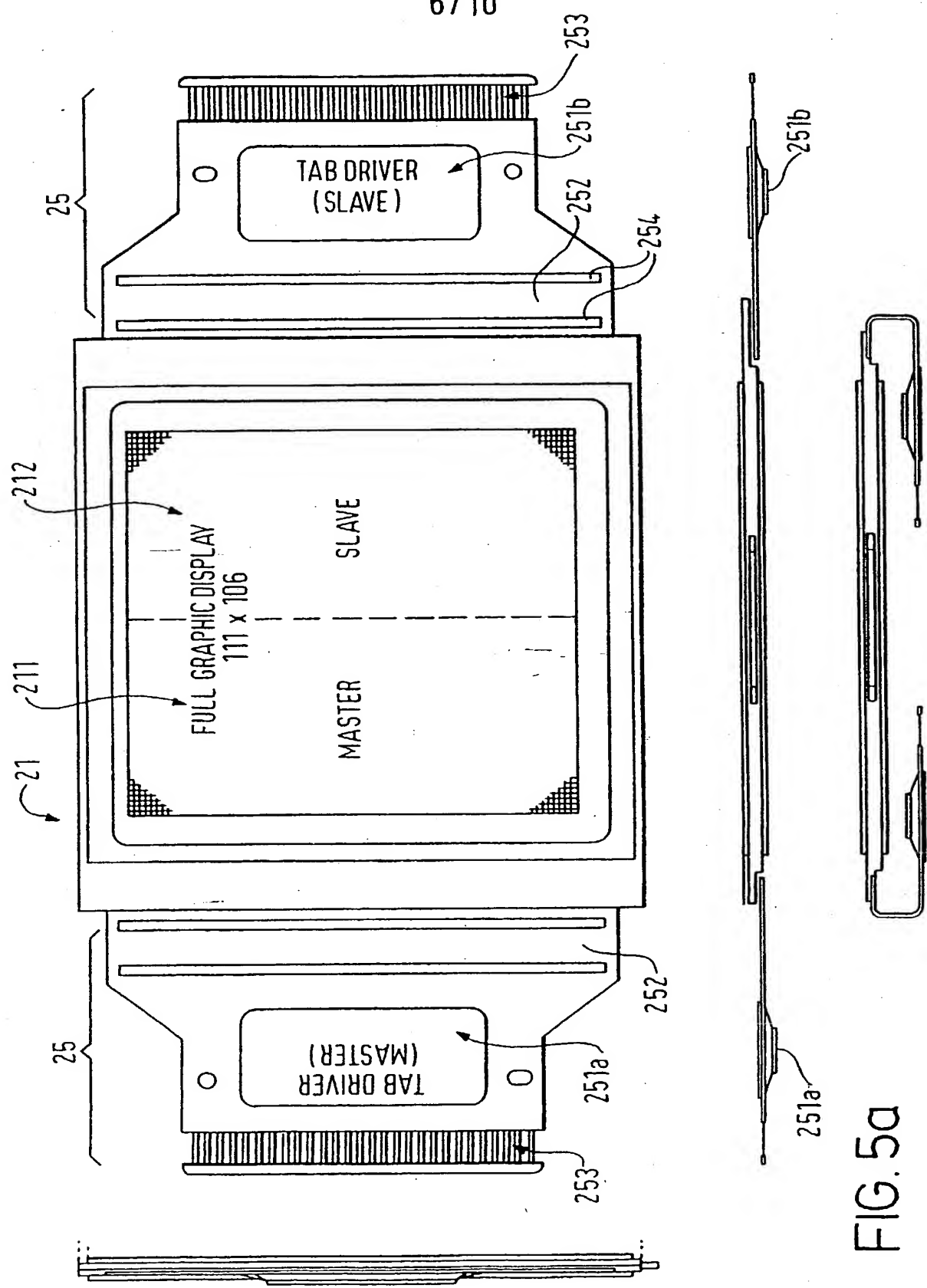


FIG. 5a

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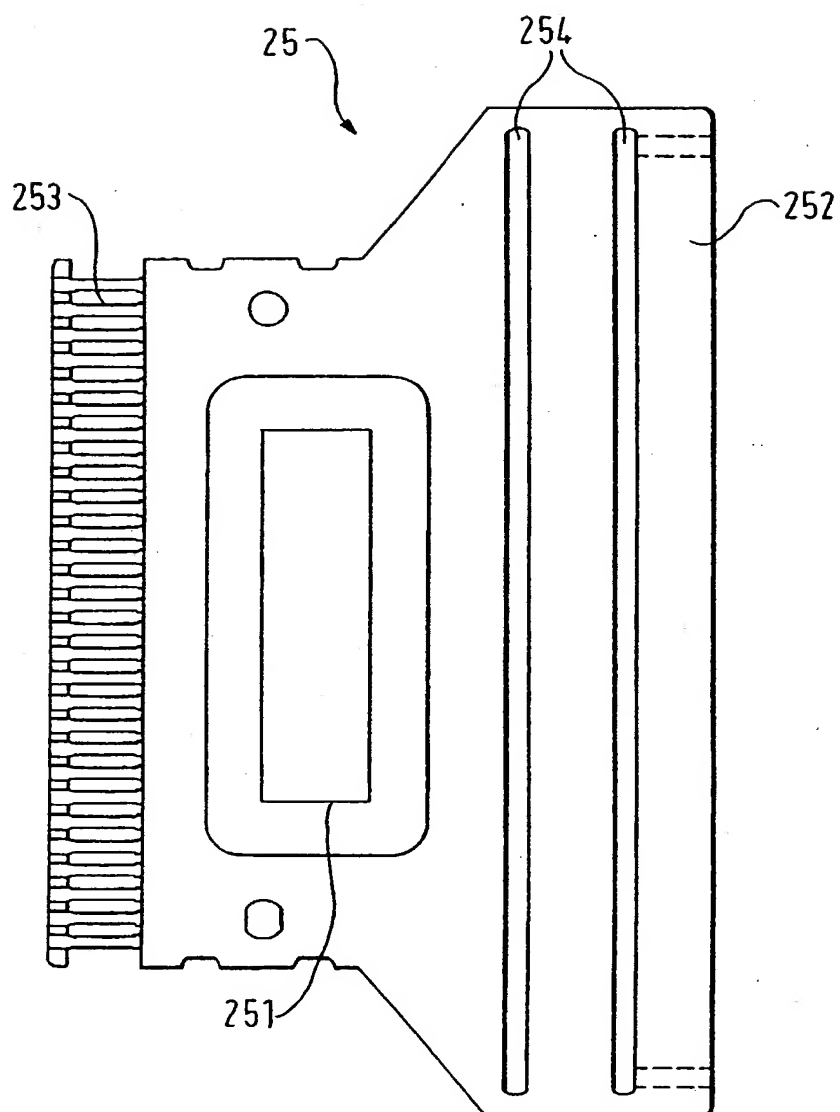


FIG. 5b

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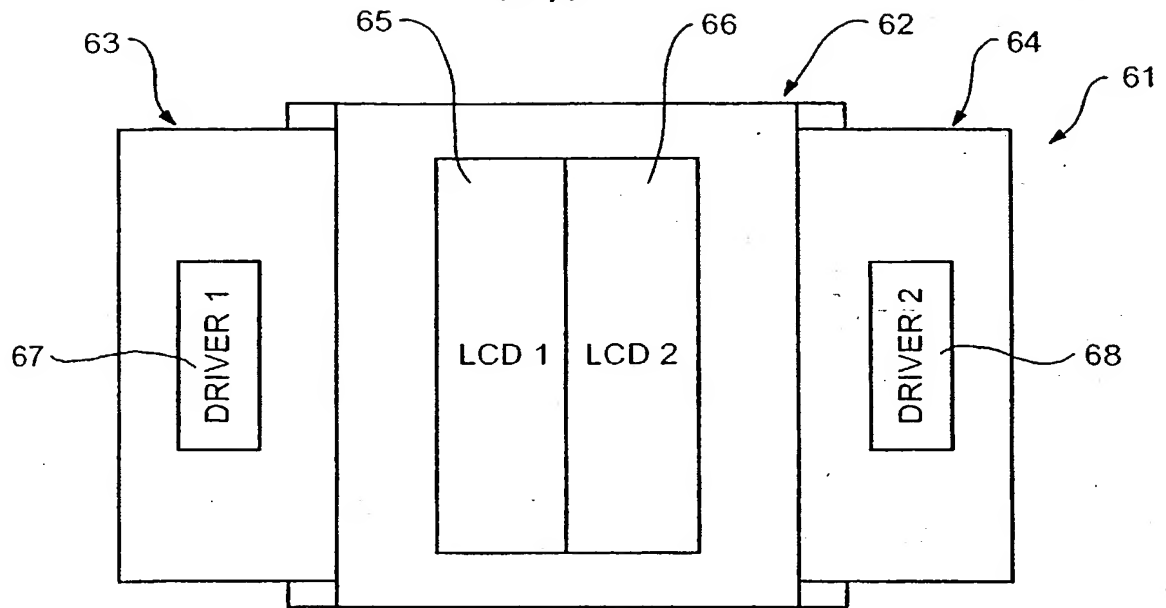


FIG. 6a

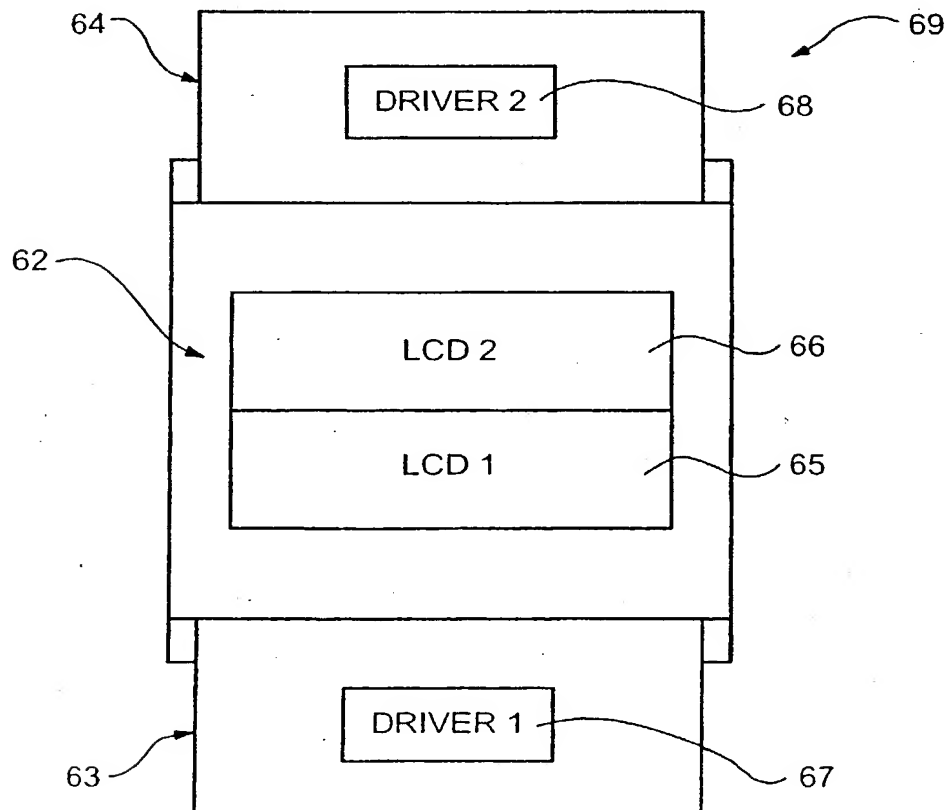


FIG. 6b

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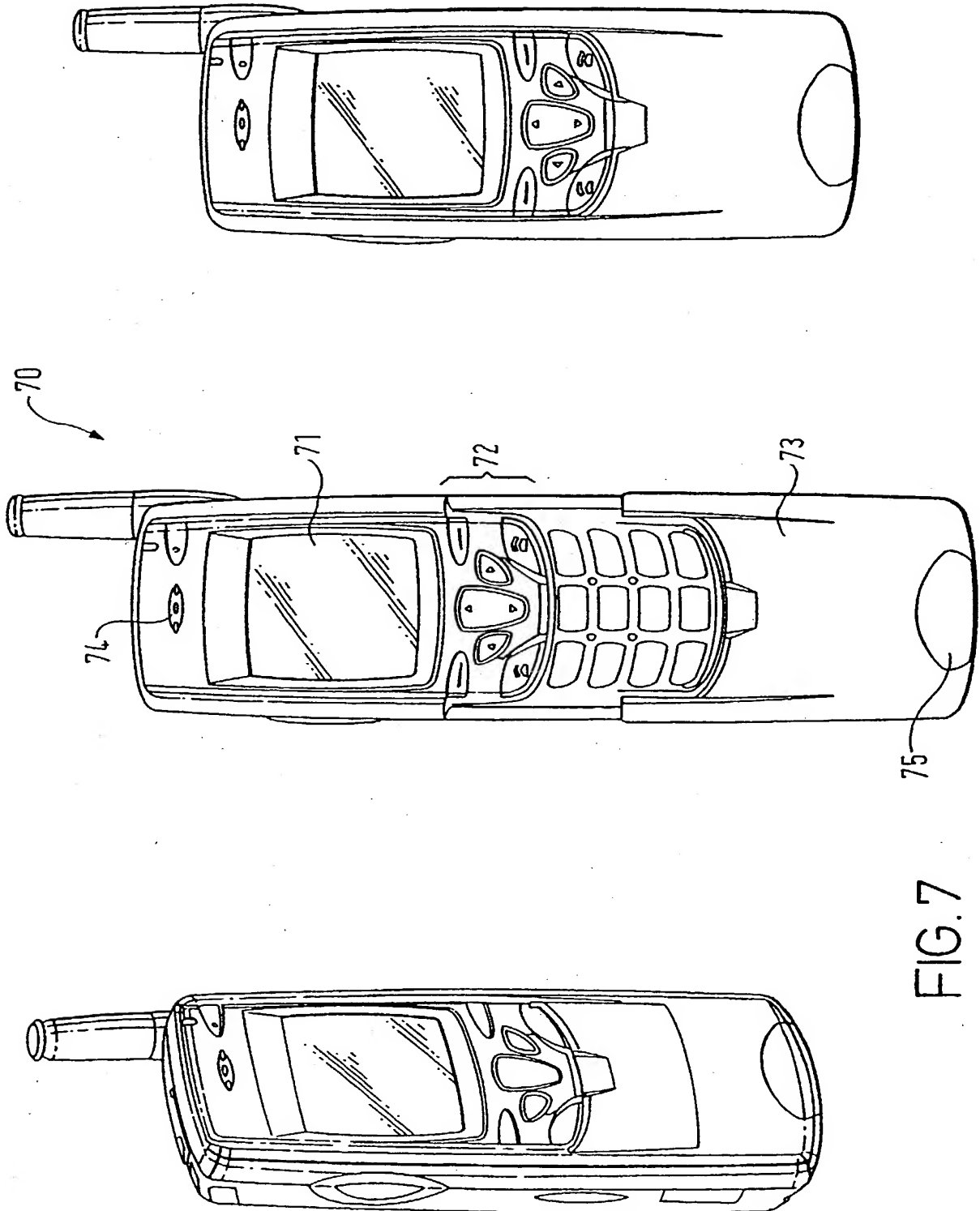
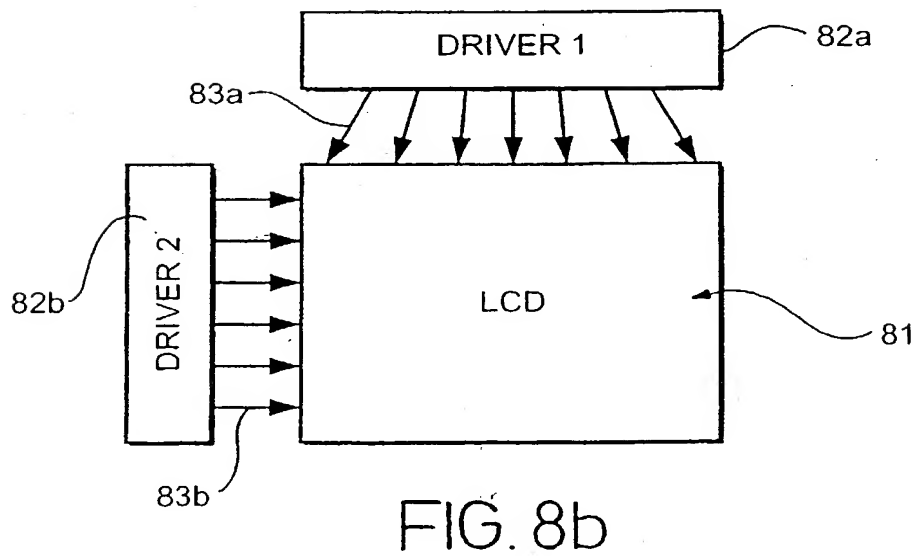
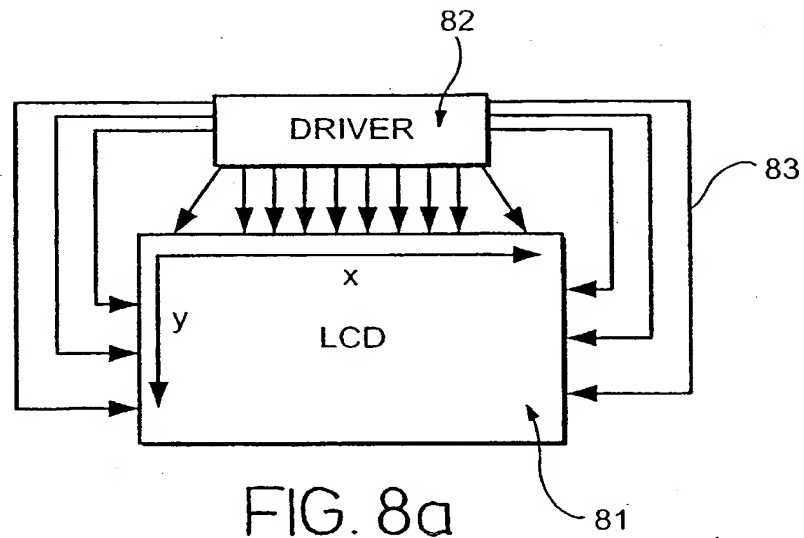


FIG. 7

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Attorney's Docket No. 367.40917X00 :

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that: my residence, post office address and country of citizenship are as stated below, next to my name; I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A DISPLAY MODULE

the specification of which

is attached hereto.

X was filed on 10 December 2001 as
United States Application Number 10/009333
or PCT International Application Number PCT/GB00/02249
d was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits, under 35 U.S.C. 119(a)-(d) or 365(b), of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

			<u>Priority Claimed?</u>	
			<u>X</u>	
			Yes	No
<u>9913539.4</u>	<u>GB</u>	<u>10 June 1999</u>		
(Number)	(Country)	(Foreign Filing Date)		
<u> </u>	<u> </u>	<u> </u>		
(Number)	(Country)	(Foreign Filing Date)	Yes	No

I hereby claim the benefit, under 35 U.S.C. 119(e), of any United States provisional application(s) listed below:

<u> </u>	<u> </u>
(Application Number)	Filing Date

<u> </u>	<u> </u>
(Application Number)	Filing Date

I hereby claim the benefit, under 35 U.S.C. 120, of any United States application(s) listed below:

<u> </u>	<u> </u>	<u> </u>
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

<u> </u>	<u> </u>	<u> </u>
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint: Donald R. Antonelli, Reg. No. 20,296; Melvin Kraus, Reg. No. 22,466; William I. Solomon, Reg. No. 28,565; Gregory E. Montone, Reg. No. 28,141; Ronald J. Shore, Reg. No. 28,577; Donald E. Stout, Reg. No. 26,422; Alan E. Schiavelli, Reg. No. 32,087; James N. Dresser, Reg. No. 22,973; Carl I. Brundidge, Reg. No. 29,621; Paul J. Skwierawski, Reg. No. 32,173; and Robert M. Bauer, Reg. No. 34,487; of ANTONELLI, TERRY, STOUT & KRAUS, LLP with offices located at 1300 North Seventeenth Street, Suite 1800, Arlington, Virginia 22209, my attorneys, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

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FAX: (703) 312-6666

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's Signature *I. David Lewis*

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2-00 Full Name of Second/Joint Inventor TERENCE PHILIP JOHNSON

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Date 30/7/02

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(City, State)

(Country of Citizenship)

Mailing Address As above

Full Name of Third/Joint Inventor _____

Inventor's Signature _____

Date _____

Residence _____

Citizenship _____

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(Country of Citizenship)

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Washington, D.C. 20231

Application Number

JC07 Rec'd PCT/PTO 10 DEC 2001

Filing Date

December 10, 2001

First Named Inventor

JOHNSON, Terrence P.

Group Art Unit

Examiner Name

Attorney Docket Number

367.40917X00

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Printed Name

Carl I. Brundidge

Registration NO. 29,621

Signature

Date

December 10, 2001

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